1. OPERATIONAL PROCEDURES

1.1 GENERAL

The Joint Typhoon Warning Center (JTWC) provides a variety of routine products and services to the organizations within its area of responsibility (AOR), including:

1.1.1 SIGNIFICANT TROPICAL WEATHER ADVISORY — Issued daily or more frequently as needed, to describe all tropical disturbances and their potential for further development during the advisory period. A separate bulletin is issued for the western Pacific and the Indian Ocean.

1.1.2 TROPICAL CYCLONE FORMATION ALERT — Issued in a specified area when synoptic, satellite, or other germane data indicate that the development of a significant tropical cyclone is likely within 12 to 24 hours.

1.1.3 TROPICAL CYCLONE/ TROPICAL DEPRESSION WARNING — Issued periodically throughout each day to provide forecasts of position, intensity, and wind distribution for tropical cyclones in JTWC's AOR.

1.1.4 PROGNOSTIC REASONING MESSAGE — Issued with warnings for tropical storms, typhoons and super typhoons in the western North Pacific to discuss the rationale for the content of the specific JTWC warning.

1.1.5 PRODUCT CHANGES — The contents and availability of the above JTWC products are set forth in USCINCPACINST 3140.1V. Changes to USCINCPACINST 3140.1V and JTWC products and services are proposed and discussed at the annual U.S. Pacific Command (PACOM) Tropical Cyclone Conference.

1.2 DATA SOURCES

1.2.1 COMPUTER PRODUCTS — Numerical and statistical guidance are available from the USN Fleet Numerical Meteorology and Oceanography Center (FLENUMETOCCEN) at Monterey, California. These products along with selected ones from the National Meteorological Center (NMC) Suitland Maryland are received by microcomputer dial-up connections using military and commercial telephone lines. Numerical model guidance is also received from international sources as well.

1.2.2 CONVENTIONAL DATA — These data sets are comprised of land and shipboard surface observations, and enroute meteorological observations from commercial and military aircraft (AIREPS) recorded within six hours of synoptic times, and cloud-motion winds derived from satellite data. The conventional data are hand- and computer-plotted, and hand-analyzed in the tropics for the surface/gradient and 200-mb levels. These analyses are prepared twice daily from 0000Z and 1200Z synoptic data. Also, FLENUMETOCCEN supplies JTWC with computer generated analyses and prognoses, from 0000Z and 1200Z synoptic data, at the surface, 850-mb, 700-mb, 500-mb, 400-mb, and 200-mb levels, deep-layer-mean winds, wind shear, and geopotential height-change charts.

1.2.3 SATELLITE RECONNAISSANCE — Meteorological satellite imagery recorded at USAF/USN ground sites and USN ships supply day and night coverage in JTWC's AOR. Interpretation of these satellite data provides tropical cyclone positions and estimates of current and forecast intensities (Dvorak, 1984). The USAF tactical satellite sites and Air Force

Global Weather Central (AFGWC) currently receive and analyze special sensor microwave/imager (SSM/I) data to provide locations of tropical cyclones of which the center is obscured by cirrus clouds, and estimates of 35-kt (18 m/sec) wind radii near tropical cyclones. In addition, the Naval Oceanographic Office forwards scatterometer data. Use of satellite reconnaissance is discussed further in section 2.3 Satellite Reconnaissance Summary.

1.2.4 RADAR RECONNAISSANCE — Land-based radar observations are used to position tropical cyclones. Once a well-defined tropical cyclone moves within the range of land-based radar sites, radar reports are invaluable for determination of position, movement, and, in the case of Doppler radar, storm structure and wind information. JTWC's use of radar reports during 1994 is discussed in Section 2.4 Radar Reconnaissance Summary.

1.2.5 AIRCRAFT RECONNAISSANCE — Until the summer of 1987, dedicated aircraft reconnaissance was used routinely to locate and determine the wind structure of tropical cyclones. Now, aircraft fixes are only rarely available from transiting jet aircraft or from weather reconnaissance aircraft involved in research missions.

1.2.6 DRIFTING METEOROLOGICAL BUOYS — In 1989, the Commander, Naval Meteorology and Oceanography Command (COMNAVMETOCCOM) put its Integrated Drifting Buoy Plan (1989-1994) into action to meet USCINCPACFLT requirements that included tropical cyclone warning support. In 1994, 30 drifting buoys were deployed in the western North Pacific by a Naval Oceanographic Office-contracted C-130 aircraft. Of the 30 buoys, 24 were Compact Meteorological and Oceanographic Drifters (CMOD) with temperature and pressure sensors and six were Wind Speed and Direction (WSD) drifters with wind speed and direction, temperature and pressure. The drifters were evenly split by type over two deployments - the first in June followed by the second in August. The purpose of the split deployment was to overlap the expected three month lifespans of the CMOD buoys in order to provide continuous coverage during the peak of the western North Pacific tropical cyclone season.

1.2.7 AUTOMATED METEOROLOGICAL OBSERVING STATIONS (AMOS) — Through a cooperative effort between the COMNAVMETOCCOM, the Department of the Interior, and NOAA/NWS to increase data available for tropical analysis and forecasting, a network of 20 AMOS stations is being installed in the Micronesian Islands (see Tables 1-1 and 1-2). Previous to this effort, two sites were installed in the Northern Mariana Islands at Saipan and Rota through a joint venture between the Navy and NOAA/NWS. The site at Saipan relocated to Tinian in 1992. Since September of 1991, the capability to transmit data via Service ARGOS and NOAA polar orbiting satellites has been available as a backup to regular data transmission to the Geostationary Operational Environmental Satellite (GOES) West, and more recently for sites to the west of Guam, to the Japanese Geostationary Meteorological Satellite (GMS). Upgrades to existing sites are also being accomplished as the opportunity arises to enable access to the ARGOS-system. JTWC receives data from all AMOS sites via the AWN under the KWBC bulletin headers SMPW01, SIPW01 and SNPW01 (SXMY10 for Tinian and Rota).

1.3 COMMUNICATIONS

Primary telecommunications support is being provided by the Naval Telecommunications Center (NTCC), Nimitz Hill, a component of the Naval Computers and Telecommunications Area Master Stations,

Table 1-1 AUTOMATED METEOROLOGICAL OBSERVING STATIONS SUMMARY

Site	Location	Call sign	ID#	System	Installed
Rota	14.2°N, 145.2°E	15D16448	91221	ARC	1987
Enewetak	11.4°N, 162.3°E	ENIP2	91251	C-MAN/ARGOS	1989
Pagan	18.1°N, 145.8°E	PAGP2	91222	C-MAN/ARGOS	1990
Kosrae	5.3°N, 163.0°E	KOSP2	91355	C-MAN/ARGOS	1990
Mili	6.1°N, 171.8°E	MILP2	91377	C-MAN	1990
Oroluk	7.6°N, 155.1°E	ORKP2	91343	C-MAN	1991
Pingelap	6.3°N, 160.7°E	PIGP2	91352	C-MAN/ARGOS	1991
Ulul	8.7°N, 149.7°E	-----	91328	C-MAN/ARGOS	1992
Tinian	15.0°N, 145.6°E	15D151D2	91231	ARC	1992
Satawan	5.3°N, 153.7°E	SATP2	91338	C-MAN/ARGOS	1993

ARC = Automated Remote Collection system (via GOES West)
C-MAN = Coastal-Marine Automated Network (via GOES West or GMS)
ARGOS = Service ARGOS data collection (via NOAA's TIROS-N)

Table 1-2 PROPOSED AUTOMATED METEOROLOGICAL OBSERVING STATIONS

Site	Location	Installation	Delayed
Pulusuk	6.5°N, 149.5°E	1993	Yes*
Ulithi	10.1°N, 139.8°E	1993	Yes**
Ngulu	8.3°N, 137.5°E	1993	Yes**
Faraulep	8.1°N, 144.6°E	1994	Yes**
Eauripik	6.7°N, 143.0°E	1994	Yes**
Maloelap	8.7°N, 171.2°E	1994	Yes
Utirik	11.2°N, 169.8°E	1994	Yes
Satawal	7.3°N, 147.0°E	1995	Yes
Ujelang	9.8°N, 160.9°E	1995	Yes
Ebon	4.6°N, 168.7°E	1995	Yes
Maug	20.0°N, 145.2°E	1996	No

* Runway construction
** Testing of GMS transmission packages

Western Pacific (NCTAMS WESTPAC). NPMOCW/JTWC recently transitioned from a circuit limiting microwave configuration to a fully expandable fiber optic based system. In the future this new configuration will expand to eliminate the Nimitz Hill NTCC from the path between NPMOCW/JTWC and NCTAMS WESTPAC and streamline each circuit in the process. Systems and their configurations which are available to JTWC follow.

1.3.1 AUTOMATED DIGITAL NETWORK (AUTODIN) — AUTODIN is in the process of transitioning to the Defense Messaging System (DMS). The Gateguard system changed from using a long-haul dedicated circuit to Camp Smith, Hawaii to a dedicated STU-III (Secure Telephone Unit) dial-up operating at a 4800 baud rate via the Defense Switched Network (DSN) with NCTAMS WESTPAC. AUTODIN/DMS is used for dissemination of warnings, alerts, other related bulletins plus messages to Department of Defense (DOD) and other U.S. Government installations. These messages are relayed for further transmission over Navy Fleet Broadcasts, and Coast Guard continuous wave Morse code and voice broadcasts. AUTODIN/DMS messages can be relayed to commercial telecommunications for delivery to non-DOD users. Inbound message traffic for JTWC is received via AUTODIN/DMS addressed to NAVPACMETOCCEN WEST GU//JTWC//.

1.3.2 AUTOMATED WEATHER NETWORK (AWN) — The AWN provides weather data over the Pacific Meteorological Data System (PACMEDS). The PACMEDS, operational at JTWC since April 1988, allows Pacific-Theater agencies to receive weather information at a 1200 baud rate. JTWC uses the WINDS/AWNCOM software application package on a microcomputer to send and receive data via the PACMEDS. This system provides effective storage and manipulation of the large volume of meteorological reports available from throughout JTWC's vast AOR. Through the AWN, JTWC has access to data available on the Global Telecommunications System (GTS). JTWC's AWN station identifier is PGTW.

1.3.3 AUTOMATED WEATHER DISTRIBUTION SYSTEM (AWDS) - The AWDS has two dual monitor workstations that are networked to a communications and weather data computer server. Data are provided to the server by two 9600 baud rate circuits. Alphanumeric AWN data are supplied by Tinker AFB via one circuit, and satellite imagery and computer graphics are supplied by Air Force Global Weather Center (AFGWC) on the other. The AWDS provides JTWC with an additional source of AWN data and satellite data.

1.3.4 DEFENSE SWITCHED NETWORK (DSN) - DSN, formerly AUTOVON, is a worldwide, general purpose, switched telecommunications network for the DOD. The network provides a rapid and vital voice and data link for JTWC to communicate tropical cyclone information with DOD installations and civilian agencies. JTWC uses DSN to access, FTS2000, SprintNET networks, and commercial carriers for voice and data requirements. These requirements include the Naval Oceanography Data Distribution System (NODDS), Air Force Dial-In System (AFDIS), TELEFAX, and fallback dial-up for the Automated Tropical Cyclone Forecast (ATCF) system. The DSN telephone numbers for JTWC are 349-5240 or 349-4224.

1.3.5 TACTICAL ENVIRONMENTAL SUPPORT SYSTEM (3) (TESS(3)) - The TESS(3) has replaced the NAVAL ENVIRONMENTAL DATA NETWORK (NEDN). The TESS(3) has a primary dedicated packet switched data link to FLENUMETOCCEN and receives super-computer-generated world master-grid gridded fields, allowing for local value added tailoring of analyses and prognoses. The TESS(3) provides connectivity via the Defense Data Network (DDN) with all of COMNAVMETOCCOM Centers world-wide.

1.3.6 SPRINTNET - PUBLIC DATA NETWORK (PDN) - A commercial packet switching network that provides low-speed interactive transmission to users of FLENUMETOCCEN products. The PDN serves as a backup to the direct DDN MILNET connectivity. JTWC can request and receive FLENUMETOCCEN produced objective tropical cyclone forecast aids via SprintNET if DDN services are disrupted. SprintNET allows direct access of FLENUMETOCCEN products via the Automated Tropical Cyclone Forecast (ATCF) system. SprintNET also serves as an alternate methods of obtaining FLENUMETOCCEN analyses and forecast fields from the NODDS system.

1.3.7 DEFENSE DATA NETWORK (DDN) - The DDN is a DOD computer communications network utilized to exchange data files. Because the DDN has links, or gateways, to military information networks, it is frequently used to exchange data with the research community. JTWC's INTERNET address is 192.231.128.1 and its E-mail account is jtops@npmocw.navy.mil. The 36 OSS/OSJ address is admin@npmocw.navy.mil.

1.3.8 TELEPHONE FACSIMILE - TELEFAX provides the capability to rapidly scan and transmit, or receive, documents over commercial telephone lines or DSN. TELEFAX is used to disseminate tropical cyclone advisories and warnings to key agencies on Guam and, in special situations, to DOD, other U.S. Government agencies, and the other Micronesian Islands. Inbound documents for JTWC are received at (671) 349-6143, (671) 349-6101, or (671) 349-4032. (DSN area code for Pacific is 315.)

1.3.9 LOCAL USER TERMINAL (LUT) - JTWC uses a LUT, provided by the Naval Oceanographic Office, as the primary means of receiving real-time data from drifting meteorological buoys and ARGOS-equipped AMOS via the polar orbiting TIROS-N satellites.

1.4 DATA DISPLAYS

1.4.1 AUTOMATED TROPICAL CYCLONE FORECAST (ATCF) SYSTEM — The ATCF is an advanced software program that assists the Typhoon Duty Officer (TDO) in the preparation, formatting, and dissemination of JTWC's products. It cuts message preparation time and reduces the number of corrections. The ATCF automatically displays: the working and objective best tracks; forecasts of track, intensity, and wind distribution; and, information from computer generated forecast aids and products from other agencies. It also computes the myriad of statistics calculated by JTWC. A module permits satellite reconnaissance fixes to be input from 36 OSS/OSJ into the LAN. The ATCF is also used to transmit the Tropical Cyclone bogus for FLENUMETOCCEN for use in NOGAPS

1.4.2 TESS(3) receives, processes, stores, displays and prints copies of FLENUMETOCCEN data and environmental products. It also ingests and displays satellite imagery from the Naval Meteorological Data Receiver-Recorder Set (SMQ-11) and other TESS(3) sets worldwide.

1.4.3 AWDS functions are similar manner to that of the TESS(3), but the environmental products and satellite global data base imagery are produced by AFGWC.

1.4.4 NAVAL OCEANOGRAPHIC DATA DISTRIBUTION SYSTEM (NODDS) — NODDS is a personal computer (PC)-based system that uses a telephone modem to download, store and display environmental and satellite data base products from FLENUMETOCCEN.

1.4.5 NAVAL SATELLITE DISPLAY SYSTEM - GEOSTATIONARY (NSDS-G) — The NSDS-G is NAVPACMETOCCEN WEST's primary geostationary imagery processing and display system. It can be used to process high resolution geostationary imagery for analysis of tropical cyclone positions and intensity estimates for the western Pacific Ocean should the the Meteorological Imagery, Data Display, and Analysis System (MIDDAS) fail.

1.4.6 PC-BASED WEATHER FACSIMILE (PCGRAFAX) SYSTEM — PCGRAFAX is a microcomputer-based system that receives, stores and displays analog and digital facsimile products that are transmitted over high frequency (HF) radio.

1.4.7 SATELLITE WEATHER DATA IMAGING SYSTEM (SWDIS) — The SWDIS (also known as the M-1000) is a PC-based system that interfaces with the LAN to retrieve, store, and display various products such as: geostationary satellite imagery from other NSDS-G sites at Rota (Spain), Pearl Harbor (Hawaii), or Norfolk (Virginia), scatterometer data from NAVOCEANO, and composites of global geostationary satellite imagery from the Internet. The SWDIS has proven instrumental in providing METEOSAT reduced-resolution coverage of tropical cyclones over the western Indian Ocean.

1.5 ANALYSES

The JTWC TDO routinely performs manual streamline analyses of composite surface/gradient-level (3000 ft (914 m)) and upper-tropospheric (centered on the 200-mb level) data for 0000Z and 1200Z daily. Computer analyses of the surface, 925-, 850-, 700-, 500-, 400-, and 200-mb levels, deep-layer-mean winds, frontal boundaries depiction, 1000-200 mb/400-200 mb/and 700-400 mb wind shear, 500 mb and 700 mb 24-hour height change, and a variety of other meteorological displays come from the 0000Z and 1200Z FLENUMETOCCEN data bases. Additional sectional charts at intermediate synoptic times and auxiliary charts, such as station-time plot diagrams, time-height cross section charts and pressure-change charts, are analyzed during periods of significant tropical cyclone activity.

1.6 FORECAST PROCEDURES

1.6.1 INITIAL POSITIONING — The warning position is the best estimate of the center of the surface circulation at synoptic time. It is estimated from an analysis of all fix information received from one hour before to one and one-half hours after that synoptic time. The analysis is aided by a computer-generated objective best track scheme that weights fix information based on its statistical accuracy. The TDO includes synoptic observations and other information to adjust the position, testing consistency with the past direction, speed of movement and the influence of the different scales of motion. If the fix data are not available due to reconnaissance platform malfunction or communication problems, or are considered unrepresentative, synoptic data and/or extrapolation from previous fixes are used.

1.6.2 TRACK FORECASTING — In preparing the JTWC official forecast, the TDO evaluates a wide variety of information, and employs a number of objective and subjective techniques. Because tropical cyclone track forecasting has and continues to require a significant amount of subjective input from the TDO, detailed aspects of the forecast-development process will vary somewhat from TDO to TDO, particularly with respect to the weight given to any of the available guidance. JTWC uses a standardized, three-phase tropical cyclone motion forecasting process to improve not only track forecast accuracy, but also intensity forecast accuracy and forecast-to-forecast consistency.

1.6.2.1 Field Analysis Phase — Navy Operational Global Atmospheric Prediction System (NOGAPS) analyses and prognoses at various levels are evaluated for position, development, and movement of not only the tropical cyclone, but also relevant synoptic features such as: 1) subtropical ridge circulations, 2) mid-latitude short/long-wave troughs and associated weaknesses in the subtropical ridge, 3) monsoon surges, 4) cyclonic cells in the Tropical Upper-Tropospheric Trough (TUTT), 5) other tropical cyclones, and 6) the distribution of sea surface temperature. This process permits the TDO to develop an initial impression of the environmental steering influences to which the tropical cyclone is and will be subjected to as depicted by NOGAPS. The NOGAPS analyses are then compared to the hand-plotted and analyzed charts prepared by the TDO and to the latest satellite imagery in order to determine how well the NOGAPS-initialization process has conformed to the available synoptic data, and how well the resultant analysis fields agree with the synoptic situation inferred from the imagery. Finally, the TDO compares both the computer and hand-analyzed charts to monthly climatology in order to make a preliminary determination of to what degree the tropical cyclone is, and will continue to be, subjected to a climatological or nonclimatological synoptic environment. Noting latitudinal and longitudinal displacements of the subtropical ridge and long-wave midlatitude features is of particular importance, and will partially determine the relative weights given to climatologically- or dynamically-based objective forecast guidance.

1.6.2.2 Objective Techniques Analysis Phase — By applying the guidance of the "Systematic and Integrated Approach,"(Carr and Elsberry, 1994) the TDO can relate the latest set of guidance given by JTWC's suite of objective techniques with the NOGAPS model prognoses and currently observed meteorological conditions. This allows the TDO to evaluate the objective techniques guidance to the following principles. First, the degree to which the current situation is considered to be, and will continue to be, climatological is further refined by comparing the forecasts of the climatology-based objective techniques, dynamically-based techniques, and past motion of the present storm. This assessment partially determines the relative weighting given the different classes of objective techniques. Second, the spread of the set of objective forecasts, when plotted, is used to provide a measure of the predictability of subsequent motion, and the advisability of including a moderate probability alternate forecast scenario in the prognostic reasoning message or warning (outside the western North Pacific). The directional spread of the plotted objective techniques is typically small well-before or well-after recurvature (providing high forecast confidence), and is typically large near the decision-point of recurvature or non-recurvature, or during a quasi-stationary or erratic movement phase. A large spread increases the likelihood of alternate forecast scenarios.

1.6.2.3 Construct Forecast Phase — The TDO then constructs the JTWC official forecast giving due consideration to the: 1) extent to which the synoptic situation is, and is expected to remain, climatological; 2) past statistical performance of the various objective techniques on the current storm; and, 3) known properties of individual objective techniques given the present synoptic situation or geographic location. The following guidance for weighting the objective techniques is applied:

a) Weight persistence strongly in the first 12 to 24 hours of the forecast period.

b) Give significant weight to the last JTWC forecast at all forecast times, unless there is significant evidence to warrant a departure. (Also consider the latest forecasts from regional warning centers, if applicable.)

c) Give more weight to the techniques that have been performing well on the current tropical cyclone and/or are expected to perform well in the current and anticipated synoptic situations.

d) Stay within the "envelope" determined by the spread of objective techniques forecasts unless there is a strong specific reason for not doing so (e.g., all objective forecasts start out at a significant angle relative to past motion of the current tropical cyclone).

e) Apply the "Systematic and Integrated Approach," (Carr and Elsberry, 1994) using conceptual models of recurving, dynamically-related meteorological patterns with the traits of the numerical and objective aid guidance associated with the specific synoptic situation.

1.6.3 INTENSITY FORECASTING — The empirically derived Dvorak (1984) technique is used as a first guess for the intensity forecast. The TDO then adjusts the forecast after evaluating climatology and the synoptic situation. An interactive conditional climatology scheme allows the TDO to define a situation similar to the system being forecast in terms of location, time of year, current intensity, and intensity trend. Synoptic influences such as the location of major troughs and ridges, and the position and intensity of the TUTT all play a large part in intensifying or weakening a tropical cyclone. JTWC incorporates a checklist into the intensity forecast procedure. Such criteria as upper-level outflow patterns, neutral points, sea-surface temperatures, enhanced monsoonal or cross-equatorial flow, and vertical wind shear are evaluated for their tendency to enhance or inhibit normal development, and are incorporated into the intensity forecast process through locally developed thumb rules. In addition to climatology and synoptic influences, the first guess is modified for interactions with land, with other tropical cyclones, and with extratropical features. Climatological and statistical methods are also used to assess the potential for rapid intensification (Mundell, 1990).

1.6.4 WIND-RADII FORECASTING — Since the loss of dedicated aircraft reconnaissance in 1987, JTWC has turned to other data sources for determining the radii of winds around tropical cyclones. The determination of wind radii forecasts is a three-step process:

a) First, low-level satellite drift winds, microwave imager 35-kt wind speed analysis (See Chapter 2), and synoptic data are used to derive the current wind distribution.

b) Next the first guess of the radii is determined from statistically-derived empirical wind radii models. JTWC currently used three models: the Tsui model, the Huntley model, and the Martin-Holland model. The latter model uses satellite-derived parameters to determine the size and shape of the wind profile associated with a particular tropical cyclone. The Martin-Holland model also incorporates latitude and speed of motion to produce an asymmetrical wind distribution. These models provide wind distribution analyses and forecasts that are primarily influenced by the intensity forecasts. The analyses are then adjusted based on the actual analysis from step a), and the forecasts are adjusted appropriately.

c) Finally, synoptic considerations, such as the interaction of the cyclone with mid-latitude high pressure cells, are used to fine-tune the forecast wind radii.

1.6.5 EXTRATROPICAL TRANSITION — When a tropical cyclone moves into the mid-latitudes, if often enters an environment that is detrimental to the maintenance of the tropical cyclone's structure and energy-producing mechanisms. The effects of cooler sea surface temperatures, cooler and dryer environmental air, and strong vertical wind shear all act to convert the tropical cyclone into an extratropical cyclone. JTWC indicates that this conversion process is occurring by stating that the tropical cyclone is "becoming extratropical." JTWC will indicate that the conversion is expected to be complete by stating that the system has become "extratropical." When a tropical cyclone is forecast to become extratropical, JTWC coordinates the transfer of responsibility with the appropriate regional NAVPACMETOCCEN, which assumes warning responsibility for the extratropical system.

1.6.6 TRANSFER OF WARNING RESPONSIBILITY — JTWC coordinates the transfer of warning responsibility for tropical cyclones entering or exiting its AOR. For tropical cyclones crossing 180° E longitude in the North Pacific Ocean, JTWC coordinates with the Central Pacific Hurricane Center (CPHC), Honolulu via the Naval Western Oceanography Center (NAVPACMETOCCEN), Pearl Harbor, Hawaii. For tropical cyclones crossing 180° E longitude in the South Pacific Ocean, JTWC coordinates with the NAVPACMETOCCEN, which has responsibility for the eastern South Pacific. Whenever a tropical cyclone threatens Guam, files are electronically transferred from JTWC to the Alternate Joint Typhoon Warning Center (AJTWC) collocated with NAVPACMETOCCEN. In the event that JTWC should become incapacitated, the AJTWC assumes JTWC's functions. Assistance in determining satellite reconnaissance requirements, and in obtaining the resultant data, is provided by the weather unit supporting the 15th Air Base Wing, Hickam AFB, Hawaii.

1.7 WARNINGS

JTWC issues two types of warnings: Tropical Cyclone Warnings and Tropical Depression Warnings.

1.7.1 TROPICAL CYCLONE WARNINGS — These are issued when a closed circulation is evident and maximum sustained 1-minute winds are forecast to reach 34 kt (18 m/sec) within 48 hours, or when the tropical cyclone is in such a position that life or property may be endangered within 72 hours.

Each Tropical Cyclone Warning is numbered sequentially and includes the following information: the current position of the surface center; an estimate of the position accuracy and the supporting reconnaissance (fix) platform(s); the direction and speed of movement during the past six hours (past 12 hours in the Southern Hemisphere); and the intensity and radial extent of over 35-, 50-, and 100-kt (18-, 26-, and 51 m/sec) surface winds, when applicable. At forecast intervals of 12, 24, 36, 48, and 72 hours (12, 24, 36 and 48 hours in the Southern Hemisphere), information on the tropical cyclone's anticipated position, intensity and wind radii is provided. Vectors indicating the mean direction and mean speed between forecast positions are included in all warnings. In addition, a 3-hour extrapolated position is provided in the remarks section.

Warnings in the western North Pacific and North Indian Oceans are issued every six hours (unless an amendment is required), valid at standard times: 0000Z, 0600Z, 1200Z and 1800Z (at a minimum every 12 hours: 0000Z, 1200Z or 0600Z, 1800Z in the Southern Hemisphere). All warnings are released to the communications network no earlier than synoptic time and no later than synoptic time plus two and one-half hours, so that recipients are assured of having all warnings in hand by synoptic time plus three hours (0300Z, 0900Z, 1500Z and 2100Z). By area, the warning bulletin headers are: WTIO31-35 PGTW for northern latitudes from 35° to 100° east longitude, WTPN31-36 PGTW for northern latitudes from 100° to 180° east longitude, WTXS31-36 PGTW for southern latitudes from 35° to 135° east longitude, and WTPS31-35 PGTW for southern latitudes from 135° to 180° east longitude.

1.7.2 TROPICAL DEPRESSION WARNINGS — These are issued only for western North Pacific tropical depressions that are not expected to reach the criteria for Tropical Cyclone Warnings, as mentioned above. The depression warning contains the same information as a Tropical Cyclone Warning except that the Tropical Depression Warning is issued every 12 hours (unless an amendment is required) at standard synoptic times and extends in 12-hour increments only through 36 hours.

Both Tropical Cyclone and Tropical Depression Warning forecast positions are later verified against the corresponding best track positions (obtained during detailed post-storm analyses) to determine the most probable path and intensity of the cyclone. A summary of the verification results for 1994 is presented in Chapter 5, Summary of Forecast Verification.

1.8 PROGNOSTIC REASONING MESSAGES

These plain language messages provide meteorologists with the rationale for the JTWC forecasts for tropical cyclones in the western North Pacific Ocean. They also discuss alternate forecast scenarios, if changing conditions indicate such potential. Prognostic reasoning messages (WDPN31-36 PGTW) are prepared to complement tropical cyclone (but not tropical depression) warnings. In addition to these messages, prognostic reasoning information may be provided in the remark section of a tropical cyclone warning.

1.9 TROPICAL CYCLONE FORMATION ALERTS

Tropical Cyclone Formation Alerts are issued whenever interpretation of satellite imagery and other meteorological data indicates that the formation of a significant tropical cyclone is likely. These alerts will specify a valid period, usually not exceeding 24 hours, and must either be canceled, reissued, or superseded by a warning prior to expiration. By area, the Alert bulletin headers are: WTIO21-25 PGTW for northern latitudes from 35° to 100°E longitude, WTPN21-26 PGTW for northern latitudes from 100° to 180°E longitude, WTXS21-26 PGTW for southern latitudes from 35° to 135°E longitude, and WTPS21-25 PGTW for southern latitudes from 135° to 180°E longitude.

1.10 SIGNIFICANT TROPICAL WEATHER ADVISORIES

This product contains a description of all tropical disturbances in JTWC's AOR and their potential for further (tropical cyclone) development. In addition, all tropical cyclones in warning status are briefly discussed and referenced.

Two separate messages are issued daily, and each is valid for a 24-hour period. The Significant Tropical Weather Advisory for the Western Pacific Ocean is issued by 0600Z. The Significant Tropical Weather Advisory for the Indian Ocean is issued by 1800Z. These are reissued whenever the situation warrants. For each suspect area, the words "poor", "fair", or "good" are used to describe the potential for development. "Poor" will be used to describe a tropical disturbance in which the meteorological conditions are currently unfavorable for development. "Fair" will be used to describe a tropical disturbance in which the meteorological conditions are favorable for development, but 1significant development has not commenced or is not expected to occur in the next 24 hours. "Good" will be used to describe the potential for development of a disturbance covered by an Alert. By area, the advisory bulletin headers are: ABPW10 PGTW for northern latitudes from 100° to 180°E longitude and southern latitudes from 135° to 180°E longitude and

ABIO10 PGTW for northern latitudes from 35° to 100°E longitude and southern latitudes from 35° to 135°E longitude.

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